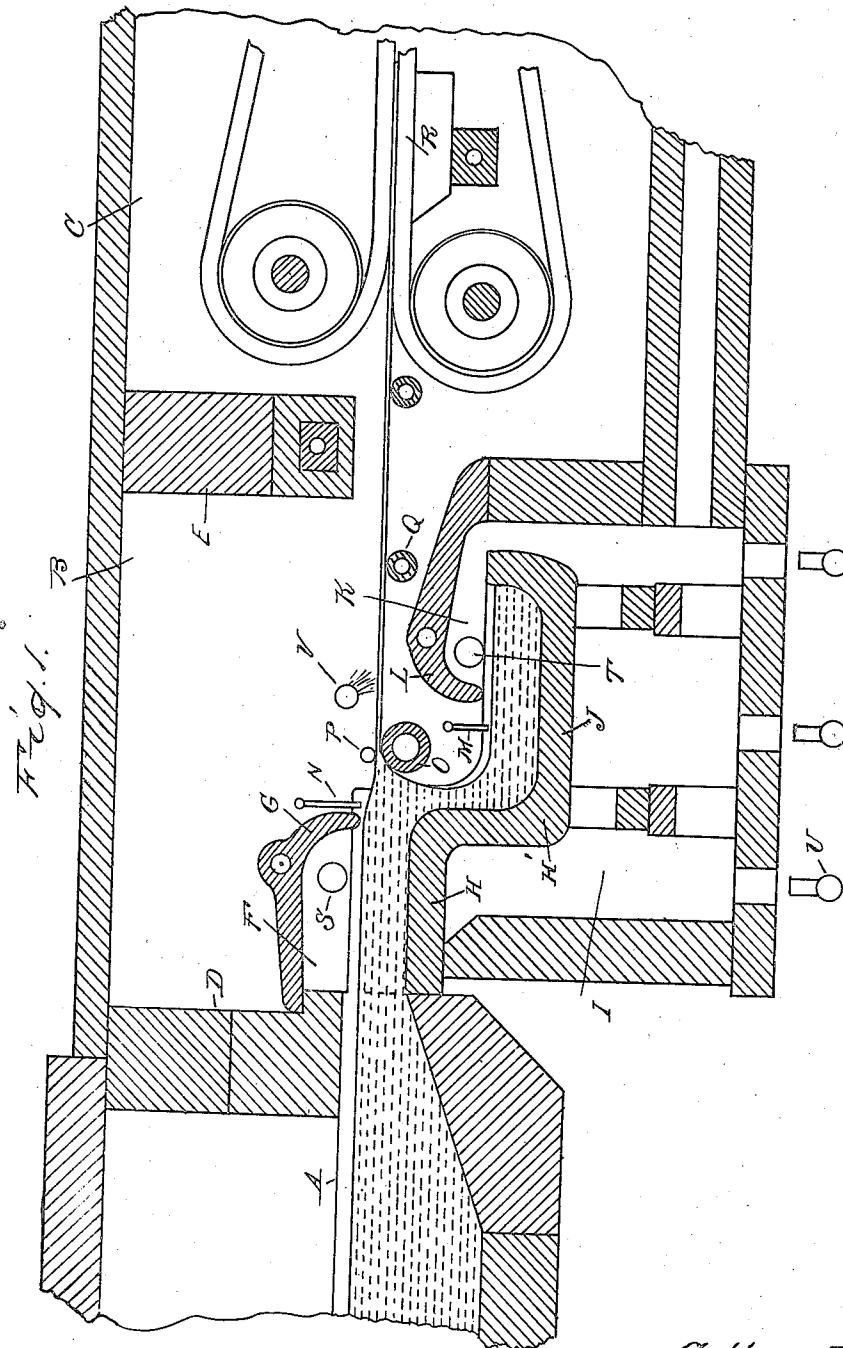


A. E. FOWLE AND J. P. CROWLEY.
 APPARATUS FOR AND METHOD OF DRAWING SHEET GLASS.
 APPLICATION FILED JULY 10, 1920.

1,435,958.

Patented Nov. 21, 1922.

4 SHEETS—SHEET 1.



Inventors
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4 SHEETS—SHEET 2.



By Whittmore Hulbert Whittmore

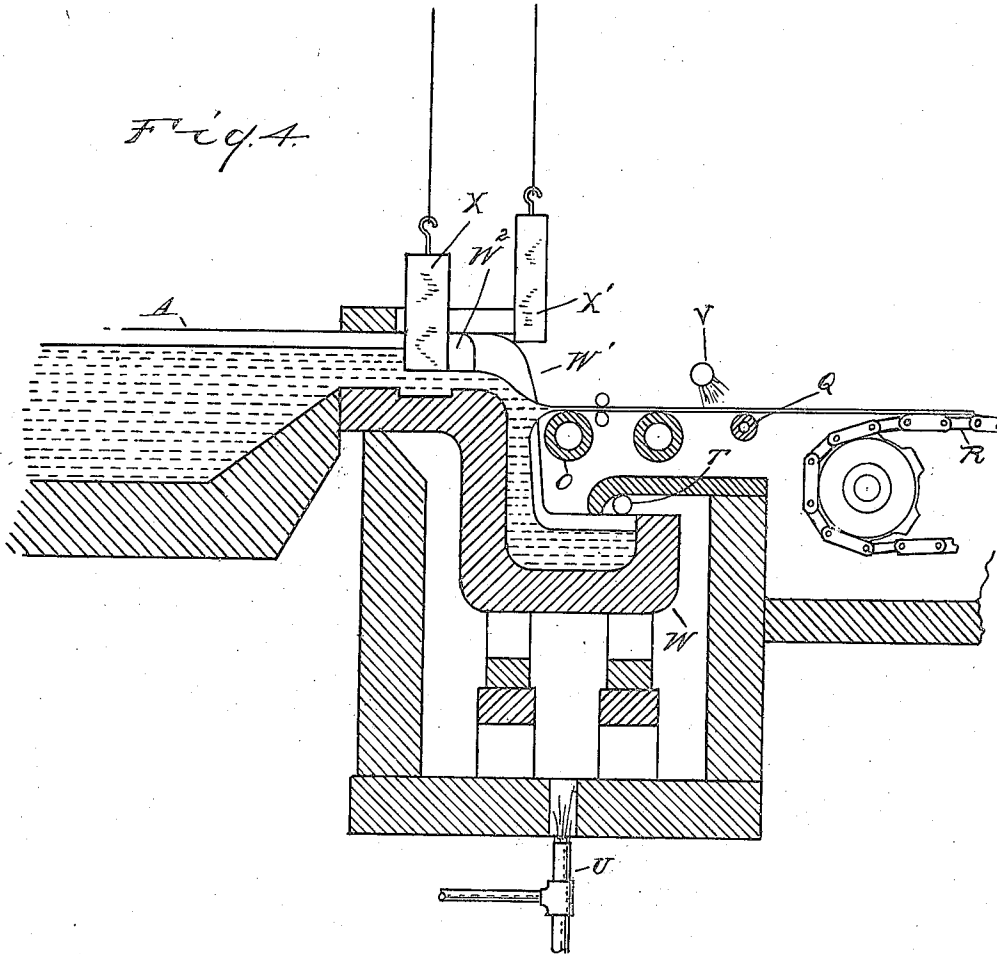
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Fig. 5.

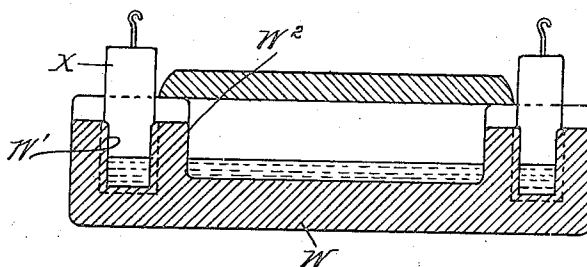
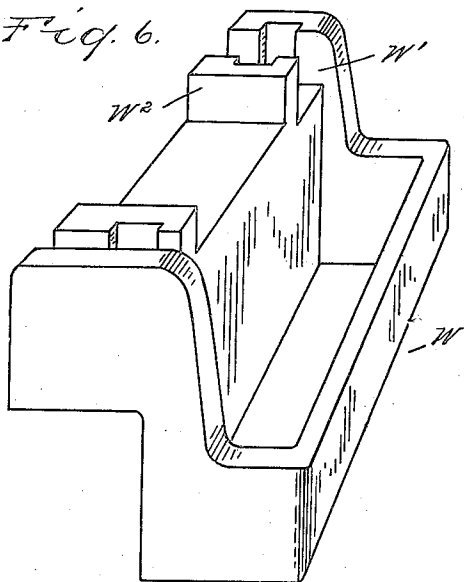


Fig. 6.



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UNITED STATES PATENT OFFICE.

ARTHUR E. FOWLE AND JOSEPH P. CROWLEY, OF TOLEDO, OHIO, ASSIGNORS TO THE
LIBBEY-OWENS SHEET GLASS COMPANY, OF TOLEDO, OHIO, A CORPORATION OF
OHIO.

APPARATUS FOR AND METHOD OF DRAWING SHEET GLASS.

Application filed July 10, 1920. Serial No. 395,305.

To all whom it may concern:

Be it known that we, ARTHUR E. FOWLE and JOSEPH P. CROWLEY, both citizens of the United States of America, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Apparatus for and Methods of Drawing Sheet Glass, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention relates to a method and apparatus for drawing sheet glass of that type, in which the sheet is initially drawn from a plastic mass, its opposite surfaces being cooled by the proximity of suitable cooling devices and the width being maintained by the engagement of edge rollers with the marginal portions of the sheet. Two more specific types of method have thus far been devised, both belonging to the general type. In the one the glass is first drawn vertically from the mass and is then passed over a bending roll into engagement with the drawing table. In the other the glass is drawn horizontally from a mass upon a slab continuing in the same direction onto the drawing table.

The present invention, while relating generally to the horizontal type, involves features of both types, as well as other features which are distinctly novel, as more fully hereinafter set forth.

In the drawings:

Figure 1 is a longitudinal section through a portion of the apparatus;

Figures 2 and 3 are diagrammatic views similar to Figure 1, showing modified constructions;

Figure 4 is a view similar to Figure 1, showing still another modification;

Figure 5 is a cross-section thereof; and

Figure 6 is a perspective view showing the tile construction.

The general type of method and apparatus above referred to is a well-known state of the art, and we shall therefore omit a full illustration and description of the same, referring only to such portions as are modified by our improved method and apparatus.

As shown in Figure 1, A is what is known as the cooling tank, which contains a mass of glass supplied from the melting and refining tank (not shown). B is the working

chamber, and C is the drawing chamber arranged in alignment with the tank A, being separated therefrom and from each other by walls D and E. F is a heated chamber at the front of the cooling chamber, which is formed by a lip tile G with its downturned portion extending into proximity to the surface of the glass. H is a slab below the glass in the heated chamber F, which is maintained at the required temperature by a heated chamber I therebeneath.

In the horizontal type of drawing above referred to, the glass is drawn off from the slab and after traveling over one or more idler rollers and past the point of engagement with the edge rollers, passes onto the drawing table. Some difficulty has been experienced by the tendency of the glass to chill on its under side at the point of leaving the slab and in fact, in the difference in conditions effecting the formation of the upper and lower surfaces of the sheet. With our improvement instead of drawing the glass directly off from the slab, only the portion which forms the top surface of the sheet is drawn from the mass on the slab, while the portion forming the lower surface of the sheet is drawn from an auxiliary mass. This establishes substantially uniform conditions in the forming of both surfaces of the sheet.

In detail and as shown in Figure 1, J is an extension of the slab H at a lower level, forming a receptacle for the auxiliary mass or pool of molten glass which flows thereinto from off the higher level H. Above this receptacle is arranged a heated chamber K, preferably formed by a lip tile L. M is a cooler for the surface of the glass arranged between the heated chamber K and the down-flowing portion of the glass, and N is a similar cooler arranged above the surface of the glass adjacent to the heating chamber F. O is a cooled idler roll, over which the sheet of glass is drawn, this roll being arranged below the level of the glass on the slab H and above the level of the glass on the slab J. P are edge rolls engaging the marginal edges of the sheet at opposite ends of the roll O.

With the construction as described, when the glass from the supply pool in tank A is permitted to flow outward over the slab H, a portion will flow downward over the vertical

portion H' of the slab between the portions H and J and will supply the glass for the auxiliary mass or pool below the heated chamber K. After the drawing of the sheet is established, (by the use of a bait, as has been the practice heretofore) a portion of the glass forming this sheet will be drawn from the top surface of the mass on the slab H beneath the heated chamber F, while another portion will be drawn from the top surface of the auxiliary mass on the slab J beneath the heated chamber K. The coolers M and N will sufficiently chill the surface, so that it can be drawn and the portion which is turned from the lower level will be drawn upward and about the cooled idler roll O, thereby forming the lower surface of the sheet. The roll O has its surface highly polished and maintained at such a temperature that the glass will not adhere thereto, but will be drawn off and over the carrier rolls Q to the drawing table R.

With the modified construction shown in Figure 2, the arrangement of the upper and lower masses on the slabs H and J is substantially the same; but instead of placing the roll O and the plane of the drawing table below the level of the mass on the slab H, they are arranged somewhat above the level thereof. This will cause an upward drawing of the glass, which forms both the upper and lower surface of the sheet. In Figure 3 the arrangement is the reverse, the roll O and the plane of the drawing table being considerably below the level of the glass on the slab H, but above the level of the glass on the slab J. Therefore, the glass forming the upper portion of the sheet will flow downward and the glass forming the lower portion of the sheet will be drawn upward.

To supply the necessary heat in the chambers F and K, gas burners, or other heating means, indicated at S and T, may be employed and burners U are provided for supplying heat in the chamber I. There is also arranged a burner V above the sheet after it is passed beyond the roll O for suitably softening the same.

To maintain the proper quantity of glass at the lower level, so as to supply that drawn in the formation of the sheet and to avoid any over-flow, any suitable means may be provided. One method of regulating the amount is to adjust the roll O towards or from the slab H, thereby altering the depth of the down-flowing stream which supplies the lower level.

Another method is shown in Figure 4, in which the glass is supplied to the lower level by streams which are separate from the portion from which the sheet is drawn. Thus as shown in Figure 6, the tile W forming the upper slab H, the lower slab J and the vertical connecting portion H' is provided with side channels W' separated from the portion

of glass from which the sheet is drawn by the intermediate walls W². These channels W' are of greater depth so as to permit of the flowing of a larger stream of glass there-through and the quantity is regulated by gates X, which may be vertically adjusted. A gate X' is also provided for closing the central channel when the apparatus is not in use. With this construction the quantity of glass which flows through the central channel may be regulated so as to supply all that is required for the upper portion of the sheet, but insufficient for maintaining the mass at the lower level. The additional quantity may then be regulated by varying the position of the gates X, which will increase or diminish the size of the streams flowing through the channels W'.

It will be observed that in the construction shown in Figure 4, the sheet is drawn laterally from a vertically extending mass and that the effect is substantially the same as where the sheet is drawn vertically from a horizontal mass, while at the same time it avoids the necessity of changing the direction of drawing or the use of a bending roll.

What we claim as our invention is:

1. The method of forming sheet glass, comprising the drawing of the opposite surface portions thereof from pools of molten glass maintained at different levels.
2. The method of forming sheet glass, comprising the drawing of portions forming the opposite surfaces thereof from the surfaces of pools of molten glass maintained at different levels.
3. The method of forming sheet glass, comprising the drawing of the portions for forming the opposite surfaces thereof from connected pools of molten glass arranged at different levels.
4. The method of forming sheet glass, comprising the drawing of portions forming the opposite surfaces thereof from pools of molten glass arranged at different levels with a flowing connection between the upper and lower level.
5. The method of forming sheet glass, comprising the drawing of portions forming the opposite surfaces thereof from pools of molten glass arranged at different levels having a flowing connection therebetween, the portion forming the lower surface of the sheet being derived from the surface of the lower pool and drawn upward over the surface of the flowing connection.
6. The method of forming sheet glass, comprising the drawing of portions forming the opposite surfaces thereof from the surface portions of pools of molten glass arranged at different levels and connected by a vertically extending portion.
7. The method of forming sheet glass, comprising the drawing of the sheet laterally from a vertically extending mass of plastic

glass, the vertically extending mass being constantly renewed from both its upper and lower ends.

8. The method of forming sheet glass, comprising the drawing of the sheet laterally from two pools of molten glass arranged at different levels.

9. The method of forming sheet glass, comprising the drawing of the sheet laterally from a vertically extending mass of plastic glass, which connects pools of molten glass at two different levels, the glass forming the lower surface portion of the sheet being drawn from an upwardly moving surface portion of said vertical mass, and applying glass to the pool at the lower level in regulated quantities.

10. In an apparatus for drawing sheet glass, means for supporting a vertically extending mass of plastic glass, separate pools of molten glass for feeding this mass at both its upper and lower ends, and means for drawing the sheet laterally from the vertically extending mass.

11. An apparatus for drawing sheet glass, comprising means for flowing a stream of plastic glass from an upper to a lower level, and means for drawing the entire sheet laterally from an intermediate portion of said flowing stream.

12. In an apparatus for drawing sheet

glass, two receptacles for plastic glass arranged at different levels, and connecting means therebetween for a flowing stream of glass, and means arranged above the level of the lower receptacle for the lateral drawing of a sheet from the connecting stream.

13. In an apparatus for drawing sheet glass, two heated receptacles for plastic glass, arranged at different levels with a heated slab therebetween, over which a stream of glass flows from one receptacle to the other, and means arranged above the level of the lower receptacle for drawing a sheet laterally from said stream.

14. In an apparatus for drawing sheet glass, two receptacles for plastic glass arranged at different levels and having a connecting slab therebetween, over which a stream of glass flows from one receptacle to the other, heating chambers above portions of each of said receptacles, cooling means for the surface of the glass between said heating chambers, and means arranged above the level of the lower receptacle for drawing a sheet laterally from the stream between receptacles.

In testimony whereof we affix our signatures.

ARTHUR E. FOWLE.
JOSEPH P. CROWLEY.